Committee on Resources

Testimony

Subcommittee on Water and Power
Saturday, May 31, 1997
Lewiston, Idaho

Testimony of
James J. Anderson
Associate Professor
School of Fisheries
University of Washington
Seattle Washington
before the
U.S. House of Representatives
Subcommittee on Water and Power
in
Lewiston Idaho
May 31, 1997

Testimony

My name is James J. Anderson, I am an associate professor in the School of Fisheries at the University of Washington. I have studied Columbia and Snake River salmon for fifteen years and my research group, (currently with five students and fourteen staff) is engaged in both field studies and quantitative analyses of the environmental and hydrosystem factors affecting the decline of salmon and the actions being taken to recover the runs. In particular, we are actively involved in evaluating the biological and physical consequences of reservoir drawdown through funding from the Bonneville Power Administration and the Army Corps of Engineers. I am a member of the PATH group (Plan to Analyze and Test Hypotheses) which was formed by the National Marine Fisheries Service and the Northwest Power Planning Council to evaluate, in detail, the scientific issues involved salmon recovery. Its members are drawn from state, tribal and federal fisheries agencies, regional universities, and private consultants. In addition, I am participating in the Army Corps of Engineers Dissolved Gas Abatement Study (DEGAS) which is evaluating efforts to reduce dissolved gas generated by hydrosystem spill. My group developed the Columbia River Salmon Passage model (CRiSP) which is one of the analytical models being used in PATH. Finally, my students have produced theses on the migration of fish through the hydrosystem, factors controlling emergence of salmon fry, the ocean distribution of salmon and the evolutionary strategies of ocean and stream type chinook.

In my testimony I will discuss scientific studies related to drawdown and in particular the analyses to assess how drawdown will alter juvenile passage survival. I will also briefly discuss the impacts of drawdown on juvenile salmon growth and the increase of adult spawning area.

In the PATH process to evaluate for drawdown we are asking three questions:

1. What will be the impact of the construction phase?
2. What will be the effect as the river adjusts to drawdown?
3. Will the river at the new equilibrium level improve fish conditions over the current hydrosystem?

We can consider these questions in reverse order since there is no need to consider the first two questions if the answer to the third is that drawdown does not improve upon the current system.

The effect of drawdown on fish survival

To address question three, PATH scientists are considering the potential survival of juvenile migration under drawdown and then will compare this to the estimate of survival that can be obtained with fish transportation. Estimating the potential smolt survival in drawdown is actually straightforward. Using studies through the undammed portions of the system prior to the construction of the hydrosystem, and recent estimates of survival through tributaries, dams and reservoirs, we can estimate the total survival of juvenile fish traveling first through a drawndown river system stretching from Lower Granite Dam to John Day Dam and then through the three remaining dams on the lower Columbia. Assuming 90% survival through the natural river and 90% survival through each of the three remaining dam/ reservoir complexes, the combined passage survival is 66%. For drawdown to benefit juvenile survival the existing transportation system survival, including any delayed survival associated with transportation, must be under 66%.

PATH scientists are currently evaluating the total survival expected from fish passing through the combined in-river and barge passage routes. The scientists have concluded that the direct survival in barging is over 95%. If this were the only source of mortality in transportation then there would be no benefit to drawdown since juvenile passage survival would decrease considerably with drawdown. The analysis is not this straightforward though because PATH scientists have also shown that life cycle mortality, determined from the relationship of adult spawners to recruits, increased significantly in the 1980's and is coincident with the development of both the hydrosystem and the transportation program. Since studies of the direct juvenile passage survival cannot account for this increased mortality, the PATH group has concluded that the increase is likely due to post-hydrosystem mortality. An important question then is whether this recent mortality increase is associated with the Snake River hydrosystem and fish transportation or whether it is the consequence of other factors such as the 1977 climatic regime shift, changes in habitat, or differences in the seasonal flow patterns resulting from storage reservoir regulation. Many of these possible factors have had significant changes coincident with completion of the Snake River hydrosystem in 1976. Thus, ascribing reasons for this additional mortality is difficult yet critical to deciding the fates of the mutually exclusive actions: the fish transportation program and reservoir drawdown.

The current analyses in PATH are focused on assessing the contributions of climate and the hydrosystem to the additional mortality. Clearly, the contributions of each have varied over the past hundred years. Favorable ocean conditions prior to 1920 sustained high harvest rates of Columbia River fish. In 1920 a shift to a dry climate regime was coincident with the beginning of the decline in the stocks, which has brought us to the ESA listing of the Snake River stocks. In the 1950s and 60s the weather shifted to a wet pattern which was favorable to fish but masked the detrimental effects of the hydrosystem under development. In 1977 the climate regime shifted back to a dry pattern and both Columbia Basin and coastal stocks decline with a temporary increase coincident with the strong El Nino effect in the early 1980s.

Realizing that both climate and hydrosystem changes have contributed to the variations in Columbia Basin stocks over a hundred year period, the immediate problem confronting PATH scientists is to assess the contributions of the climate regime and the changes in hydro operations before and after 1977. To resolve this issue PATH scientists are incorporating a variety of information including estimates of salmon productivity between 1952 and 1990, estimates of in-river survival extending from 1966 through 1996, and a handful of estimates of the effectiveness of transportation based on adult returns of tagged salmon that were either barged or migrated in-river as juveniles.

The first PATH task was to assess the level of additional mortality. The approach was straightforward and used the stock recruitment data between 1952 and 1990. The analysis showed that mortality increased in the late 1970s, decreased in the 1980s and then increased again through 1990. In addition, based on the large number of returning spring chinook adults this year, we expect that the post- hydrosystem mortality in the 1995 outmigration was low.

Ascribing causes for the variation in additional mortality is a more difficult task because the information from adult returns alone is not sufficient to disentangle the effects of climate and the hydrosystem. One of the few approaches is to include information from the transport studies, which allows us to determine if the additional mortality of barged vs. in-river passage fish are different. That is, the approach allows us to assess if there is a "delayed mortality" associated with barging that fish migrating in-river do not experience. This question is germane to determining whether or not barging works, which then reflects on the value of drawdown as a replacement action.

Essentially all statistically significant transportation studies from 1968 through 1995 indicate that survival to adult was greater for barged fish than for in-river fish. In recent years, which best reflect the expected future hydrosystem operation, the ratio of adult survival of barged to in-river fish was about two to one. We can determine if post-hydrosystem mortality of barged and in-river fish are different with a simple calculation. Noting that two barged fish return for every one in-river fish, and with a barge survival of 100% and an in-river survival of 50% then the observed 2 to 1 ratio is achieved without a difference in the post-hydrosystem survival of the passage routes. The existing passage and barge survival data support these estimates and provide compelling evidence that there is no significant post- hydrosystem mortality from fish transporation. Thus, the additional mortality as a result of the development of the transportation program is likely the result of other factors. This evidence also suggests that the fish transportation is a viable program and drawdown will not improve upon the existing juvenile passage conditions.

It still remains to be determined why the Snake River fish have experienced a significant increase in mortality in the last decade. Eliminating transportation delayed mortality does eliminate the possibility that other hydrosystem factors may affect both in-river and barged fish. Nor does it eliminate the possibility that the decline was the result of climate factors acting outside the hydrosystem. A number of competing hypotheses of varying complexity can, and have been considered, but so far they are all vaguely articulated at an ecological level.

One hypothesis is that the hydrosystem has made the Snake River stocks more susceptible to climate changes, although no mechanism has been proposed for how this might occur. A second hypothesis is that the Snake River stocks, being further up-river than the more stable lower Columbia stocks, are naturally more responsive to climate changes. There is some support for this hypothesis: in the Fraser River, which has no dams, the up-river stocks have declined more than the down river stocks. Again, a hypothesis for how climate affects fish in this manner has not yet been detailed in ecological terms.

My personal scientific belief is that changes in climate and ocean conditions are primarily responsible for both the recent decline in Snake River spring chinook and the large increase in returns from the 1995 outmigrants. I am advocating that this scenario receive close scrutiny in the PATH process.

The effects of drawdown on fish growth and spawning area

Finally, although the discussion of the benefits and detriments of drawdown to juvenile fish survival has been PATH's first consideration there are other issues to address, including the possible benefits to juvenile growth and increased spawning in the lowered reservoir. Again many uncertainties exist with these issues but the same process used to address the survival issues can be applied. That is, we need to assess first what is the potential end state of the system with drawdown and second how different is the state from the current river system.

Concerning fish growth benefits from a natural river drawdown, the Independent Scientific Group postulated in "Return to the River" that natural river drawdown may significantly improve juvenile growth, especially for ocean type fall chinook which feed as they migrate through the river system. This claim, although qualitatively reasonable, has not been supported by actual measurements of fish food limitations. If a justification for drawdown is based on the claim that fish growth will be improved, it must first be determined that fish growth is limited in the existing system.

Drawdown can potentially increase the spawning area of ocean type fall chinook. A first order assessment of this benefit can be made using historical estimates of spawning numbers. J. Williams of NMFS has estimated (personal communication) that prior to the dams, the lower Snake River contained about 5000 adults while the total Snake River contained about 40000. Thus, a four pool Snake River drawdown is expected to increase the spawning area by about 12%. Estimates as to how long it will take for the fish to actually populate the lower river have not been developed.

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